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Open Access, Pigovian Tax, and Property Rights**

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Abstract

This article summarizes the contribution in fisheries economics by the Danish economist Jens Warming and gives a translation of his article “Aalegaardsretten” (The Danish Right to Eel Weir, 1931). Warming, provides an early reference on the problem of open access, precedes Arthur Pigou in suggesting an optimal tax as a correction measure, which I refer to as a Warming landing tax in fisheries, and explains how property rights in fisheries will lead to maximized resource rent and prevent overfishing. What is missing in Warming’s description of the problem is the dynamic aspect and that the economics of natural resources should be analyzed in a capital theoretic framework, which was later established by Anthony Scott (1955a; 1955b).

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Introduction

Gordon (1954) is the classical reference describing what is nowadays referred to as open-access. The Danish economist Jens Warming (1911) derived the same results in an article some forty years earlier, which is available in a translation by Andersen (1983). Warming's article, written in Danish, did not reach an international audience at the time. Also, he did not succeed in convincing Danish policy makers to take the economics into account when regulating fisheries. Twenty years after the first article Danish fishers demanded that the Right to Eel Weir should be abolished. The Right to Eel Weir was an exception from the freedom, which otherwise applied to marine fisheries. There was a rule in the 1931 Danish fisheries act that;

“no one can be excluded from a properly visited and marked fishing ground, but you cannot achieve any property right to be transferred to other fishermen. To this comes the exception that a coastal owner has the right to fish for eel outside his land, and a separate panel of lay assessors should regulate the demarcation between the coastal owner's right and the free fishing right. This Right to Eel Weir is very old, but was rather extended when it was to be specified in the course of the work with the 1888 fisheries act” (Warming, 1931, p 151-52).

This right also gave coast owners the right to charge a fee for the right of fishing with eel weirs near their coast. Warming (1931) reconsidered the issue and provided a second article as a response to the demand of the fishers. In this article, he developed his previous analysis and provided additional insights. The debate in 1931 faded away

leaving the law unchanged but when the debated was revived in 1955, the economic arguments remained ignored and the Danish parliament abolished the right in 1956 (Topp, 2008).

As Warming himself describe the 1911-article as an unexpected spin-off from his wage and rent book and as it was the only piece on fisheries economics together with the 1931- article, the general view has been that this area was of minor importance both in terms of interest and time devoted by Warming. However, in a diary note not long before his death, he indicate his disappointment that his mentor Harald Westergaard, a leading professor of economics in Copenhagen at the time, had fail to recognize the importance of the 1911-article and that was part of denying him the chair in Economics in 1911 (Davidsen, 1999). Further, Topp (2004) reports about unpublished manuscripts from the 1920s where Warming returns to and refine the analysis of fisheries, and that he actively tried to communicate his views on fisheries not only to other colleagues but also to leading marine biologists, politicians and journalists.

This article deals with Warming's contribution to fisheries economics, the historical context of fisheries management and externalities at the time, why he failed to reach out, and concludes with a translation of his article "Aalegaardsretten" (The Danish Right to Eel Weir, 1931).

Fisheries management and market failure in late 19th and early 20th century research

In his inaugural address at the 1883 London fisheries exhibition Professor Thomas Henry Huxley, famous for his defense of Darwin's evolutionary ideas, dwelled upon whether fish are exhaustible and concluded:

“I believe, then, that the cod fishery, the herring fishery, the pilchard fishery, the mackerel fishery, and probably all the great sea fisheries, are inexhaustible; that is to say, that nothing we do seriously affects the number of the fish. And any attempt to regulate these fisheries seems consequently, from the nature of the case, to be useless.” (Blinderman and Joyce, 1998)

This view was gradually challenged. At the end of the 19th century, the leading fisheries biologist, at the time in Northern Europe, had started to worry about decline in fish stocks in the Baltic Sea and in the North Atlantic, which led to the formation of International Council for Exploration of the Sea (ICES) in 1902 with headquarters in Copenhagen. The objective for the scientific organization was to work on practical fisheries problems and to serve as a multidisciplinary forum including all disciplines related to marine sciences (Rozwadowski, 2002). The Danish marine biologist Petersen (1903) published a paper on the biological aspects of overfishing, and the risk of depletion of a stock, although for a marine mammal, was clearly demonstrated by the case of North Pacific fur seals. During the 19th century several million animals were harvested by Russians and later by Americans, followed by severely depleted stocks and leading to formation of the North Pacific Fur Seal Commission and a treaty

that prohibited pelagic sealing in 1911 (Wilén, 1976). Still, the scientific underpinning for regulations was poor and the public pressure to continue fishing strong, leading to only modest harvest regulations (Lackey, 2005). The focus was still on biology, while incentives and fishermen's supply responses were ignored. In 1930, Canada and US formed the International Pacific Halibut Commission, which adopted the scientific recommendations and became the first major experiment in scientifically based management of harvestable surplus (Wilén and Homans, 1998). In the 1950s, which saw the birth of both modern fisheries economics (Gordon, 1954; Scott, 1955a; 1955b) as well as modern fisheries biology (Schaefer 1954; Beverton and Holt, 1957), the importance of social science started to slowly influence the field of fisheries management.

Turning back to the 1920s, the marginal revolution had completely permeated the field of economics. Arthur Pigou (1920) is generally seen as the founder of the concept external cost, but several important contributions were made before that. Medema (2007) particularly stresses the role of John Stuart Mill and Henry Sidgwick in formulating a theory of market failure, where Sidgwick distinguishes two general categories where private and social interests diverge:

“those where laissez-faire's wealth maximizing results are not in society's best interest because there is more to life than wealth, and those where laissez-faire does not even generate the wealth-maximizing result.” (Medema, 2007, p346)

The first category does not relate to Warming's work on fisheries, but for the second the link is evident. Sidgwick explicitly related to fisheries in his *Principles of Political Economy* (1883):

“Take, for instance, the case of certain fisheries, where it is clearly for the general interest that the fish should not be caught at certain times, or in certain places, or with certain instruments, because the increase of actual supply obtained by such captures is much overbalanced by the detriment it causes to the prospective supply.” (p410)

This is part of a general concern that *laissez-faire* fails to fulfill the interests and needs of future generation due to self-interested agents not fully accounting for the social impact of their actions. In addition, Sidgwick also relates to fisheries regarding another concern of *laissez fair*, the incentive to cheat (Medema, 2007):

“it would be palpably rash to trust to voluntary association for the observance of the required rules of abstinence; since the larger the number that thus voluntarily abstain, the stronger becomes the inducement offered to those who remain outside the association to pursue their fishing in the objectionable times, places, and ways, so long as they are not prevented by legal coercion.” (Sidgwick, 1883, p410)

In part II of *The Economics of Welfare* (1920) Pigou introduces externalities with the example of uncompensated damage to forests by sparks from railway engines. He then provides what in principle remains as the definition of an externality:

"one person A, in the course of rendering some service, for which payment is made, to a second person B, incidentally also renders services or disservices to other persons (not producers of like services), of such a sort that payment cannot be exacted from the benefited parties or compensation enforced on behalf of the injured parties." (Part II, Chapter IX, paragr10, 4th ed. 1932)

His core message was that if the private- deviated from the social marginal net product it lead to inefficiencies, and that these problems could be adjusted by governmental intervention like a tax. Pigou also wrote on fisheries,

"This same slackness of desire towards the future is also responsible for a tendency to wasteful exploitation of Nature's gifts. Sometimes people will win what they require by methods that destroy, as against the future, much more than they themselves obtain. ... fishing operations so conducted as to disregard breeding seasons, thus threatening certain species of fish with extinction" (Part I, ch2, paragr5)

Both Pigou and Sidgwick are concerned about future generations and that self-interested agents may fail to give future benefits the appropriate weight, implicitly due to a higher private than social discount rate. However, they fail to recognize the fundamental problem in fisheries that due to the absence of an owner too many fishermen will exploit a resource and dissipate the resource rent as Gordon (1954) established.

Fisheries Economics according to Jens Warming

In 1911 Warming wrote a book in Danish, *Wage and Rent*, that was part of an attempt to apply for a vacant chair in economics at the University of Copenhagen. The core idea, reflecting the marginal revolution, was that in a competitive economy a worker earns a wage equal to the value of his marginal product (Warming, 1931). He also gave examples when this did not hold. Fisheries were one exception where more fishermen would enter the fishery and the marginal product could be lower than the wage due the problems that occurred due to “lacks in the organization of society”. According to Warming these exceptions influenced only minor parts of the economy, and did not question the theory of marginal productivity as the general wage determinant (Topp, 2008). The fisheries exception lead to the article, *On Rent of Fishing Grounds* (Warming, 1911 and Andersen, 1983), which initially seems to have been a coincidence, but response both from the fishermen’s paper and from hydrological scientists convinced him that his ideas had practical relevance too (Warming, 1931).

The contribution of the first article by Warming (1911) can be summarized as follows:

- Under open access the potential rent in a fishery is dissipated.
- Biological regulation, e.g., closed seasons, can prevent biological overexploitation but not economic overexploitation.
- Regulation of the fishery by use of fishing licenses in order to maximize total production (maximum sustainable yield, MSY) will not maximize total rents of the fishery.

- The economic optimal level of effort is at the point where marginal revenue is equal to marginal cost.
- A tax equal to the difference between average and marginal revenue at the optimal effort level will lead to an optimal fishery.

Despite his effort Warming did not achieve the professorship in economics, due to what seems like a mixture of personal conflicts and Warming's lack of formal training in economics resulting in an absence of references to existing literature in his work.¹ Warming tried to get tenure as associate professor in 1903 and 1908, competing with the later well known Danish economist L. V. Birch, but failed despite support from his mentor Harald Westergaard. Birch got the tenure in 1908, received a professorship in early 1911, and did not support his former competitor Warming later that year. Westergaard did not manage to get support for Warming, and another of his previous students, Axel Nielsen, got the professorship. Warming wrote in his diary that Niensens's work full of references seemed to be appreciated and later, in 1924, made a bitter remark implying that his 1911 failure was due to the lack of numerous references in his work that also was seen to have too much focus on real world problems (Davidsen, 1999). In 1919 he became professor of statistics at University of Copenhagen, but he continued to focus on economics, and a couple of years later he started to write a textbook in economics. One chapter dealt with "The Flaws of Competition", including a reference to the fisheries example but also provided a rather unique almost comprehensive survey of the topics of classical welfare economics. The project met resistance among his economics colleagues as statisticians should not write textbook according to their view, and further fueled the bitter dispute with his

¹ Davidsen (1999 and 2001) provide extensive treatments of Warming's failure to get a professorship in economics.

colleagues. Warming finally completed a hand written manuscript in 1924, but the book was never published (Topp, 2002).

In 1926 Warming submitted a 230-pages essay to an international competition on “the Theory of Wages”. Again, he studied forces determining the wage level and provided the fisheries example as one exception to the general finding, and now provided a revised version of the 1911-article. He did not win but received an “honorable mention” from the committee. The recognition from the foreign colleagues may have been a further inspiration to reach an international audience for Warming and in 1932 his work on the multiplier process appeared in the *Economic Journal* (1932). Later on, Warming did publish a textbook on Danish statistics (1929) that applied an economic perspective and was used for students in economics all over the country for more than a decade. Teaching of economic theory was not Warming’s task, but he partly disregarded that and had several chapters with critique of mainstream economics and some of his own theoretical contributions including the fisheries example that he also revised for the second edition (1938) that came out a year before he died (Topp, 2008).

In 1931 Warming’s second article on fisheries was published in the *Journal of the Danish Economic Association*. He reinforces several of the points previously made, and as shown by Topp (2004) he has clarified ambiguities that existed in previous texts, but also introduces some additional features:

- A right for the coastal owner to charge a fee for the fishing right in the waters near the coast will imply a regulating effect, which corresponds to the property right of land.²

² This is similar to what Coase (1960) said some decades later in “The Problem of Social Cost”

- The right of the owner to regulate entry will prevent entry of excess fishers and the aim of the owner to maximize his own income will lead him to set a fee that will maximize the rent, which is earned when the optimal number of fishers is exploiting the fishing ground.
- Free access to the fishery can even lead to a negative marginal product, i.e., too many fishers catch too many juvenile fish implying too little is left to grow and use the available feed.
- Even in times of high unemployment it is better to keep superfluous fishers away from fishing.

Warming (1911; 1931) provide early modern references on the problem of open access. He also precedes Pigou (1920) in suggesting an optimal tax as a correction measure and I refer to such an optimal tax as a Warming landing tax in fisheries. The efficiency of a Warming landing tax was later proved by Brown (1974) and was recently revived in the context of uncertainty by Weitzman (2002). What is missing in Warming's description of the problem is the dynamic aspect and that the economics of natural resources should be analyzed in a capital theoretic framework, which was later established by Scott (1955a; 1955b). The investment rule in modern fisheries economics stipulates investment in the resource until the marginal value of investment is equal to the social discount rate (SDR).³ Unlike Pigou and Sidgwick, Warming was not concerned about the future generations, or that specific problem in achieving the social optimum of a fishery, which otherwise could have lead him to consider also the dynamic aspects of fisheries.

³ For schooling fish like anchovy and herring it implies that the growth rate of the stock should equal SDR. Following (Schaefer 1954), the modern text book example also includes the stock effect for uniformly distributed fish like halibut and cod, stating that growth rate plus the marginal cost saving from increasing the stock should equal SDR (see Clark, 1990, for details).

The Great Depression hit Denmark by the last quarter of 1930 and unemployment was high. Still, Warming (1931) argues strongly against using fisheries as a recession employment opportunity with two main arguments. First, extra fishers (those in addition to the optimal number) impose an external cost to the “optimal” fishers and dissipate the potential rent. Second, there is a negative dynamic effect due to inertia. When the up surge in the economy comes, some of those superfluous fishers will not move fast enough into more productive sectors, which limits the increase in wealth during the boom. These arguments seem alarmingly up to date at least in the context of the European Union (EU). The common fisheries policy (CFP) of the EU has as one objective to maintain employment while reducing fleet capacity. The direct effect of such policy is that it imposes extra costs, but most likely it also prevents necessary changes as any meaningful reformation of the CFP will lead to reduction in employment. For example, reduced employment is an often used argument in Europe against the introduction of the rights based management approach called Individual Transferable Quotas (ITQs).

Warming’s promotion of property rights is partly also a precursor to another seminal contribution in economics, *The Problem of Social Cost* (Coase, 1960). Warming advocates the extension of land ownership into the sea as a means to solve the negative externality from too many fishers. He discusses an offshore extension of land ownership, but acknowledges that property rights may not be maintained further out in the sea due to what Coase (1937; 1960) later labeled as transaction costs:

“In case there is an owner that can regulate the entry, resource rent will be saved... The option of regulation out in the sea has so far been excluded, and it is quite likely that the costs would outweigh the benefits from administration.”

[Warming, 1931, p. 156]

Still, Warming (1931) is much more in line with Pigou than with Coase as he implicitly thinks that a single regulation like a tax can serve the same function as a contract, and he is comfortable with the benevolent state that corrects failure of the market. He does not see the problem arising due to the absence of the right to contract.⁴ Warming’s view on distributional issues also clearly deviates from Coase:

“You can be sorry about that this social value like the land rent to the land owner slips out of the hands of society, and you have the same right to tax the value increase and the value itself like for the land. Still, it is better that the value accrues to a private holder instead of being wasted, which follows if the fishing is free. You can also enjoy that this value can be saved by a minimum of administration, which is a consequence of that the coast owner, being present anyhow, demands the fee.” (Warming, 1931, p. 156)

To Warming it would be preferable if society collected the money, while Coase did not have any such preferences. Indeed, Coase privatized the externality problem (Demsetz, 1996) and if the solution is cheaper (as the last sentence in the quotation implies), he would be happy that the money goes to the private owner and not to society.

⁴ Pigou talks about contract regarding land tenancy and the differences in time horizon between the tenant and the society. However, even here Pigou doubts the perfection of contractual resolution (Demsetz 1996).

Why did Warming fail?

The traditional view of Warming's contribution to fisheries economics and the characterization of open access is that he failed to reach an international audience because the articles were written in Danish and that fisheries biologists were not aware of his findings (Andersen, 1983). However, Warming was very active in communicating his results with a wide distribution of offprints starting with the 1911 article and continuing with the 1931 article, where the latter was sent to several leading Scandinavian marine biologists but none of them saw the potential for developing the bio-economics that later emerged during the 1950s (Topp, 2008). Obviously, Warming was able to write in English and in his 1926 essay on wage formation he did a revised version of the 1911 article implying that the core of the 1931 article was already written in English. When the Danish Right to Eel Weir was published he was working on the article that was published in *The Economic Journal* the following year. Hence, he had an English draft of the 1931 article and he knew how to publish in an international journal. Still, despite his esteem of the fisheries model he did not try to publish it internationally.⁵ Warming saw it as a duty to contribute to discussions of domestic economic policy rather than making a career as an internationally recognized economist (Davidsen, 1999), a strict interpretation of this imperative would be that if the Danish Right to Eel Weir was only of concern to Scandinavians it made sense to publish for Scandinavians in *Journal of the Danish Economic Association*. The articles on fisheries basically remained unknown to the

⁵ As pointed out by an anonymous reviewer, one may ask if there was an outlet for such an article in 1931, before the era of subfields and applied economics (see e.g. Biddle and Backhouse 2000)

international audience for fifty years until translations of the 1911 article were provided (Hannesson and Anderson, 1981 and Andersen, 1983).⁶

Concerning the public debate about the Danish right of eel weir Warming did not only participate with his 1931 article but also deliberately sent copies of the article to fisheries newspapers, high ranked civil servants within the fishing authorities, and politicians including the prime minister, previously minister of fisheries, and to the minister of defense who had been on the committee investigating the issue in 1919. From what we know, Warming did not receive any feedback. Scientists did not include the economics neither in their research, nor in their policy advice. The distance between the two disciplines was too big at the time (Topp, 2008). One of the scientist addressees, H. M. Kyle, a biological secretary to ICES, had stated his view on economics in an article written in 1905 “...the problem of overfishing might ultimately be an economic one, at the mercy of the undeveloped discipline of economics” (Rozwadowski 2002, 51). The debate in 1931 ended without any change, but when the issue was revived in 1955 with another parliamentary committee report, it lead to the parliament deciding to abolish the right in 1956. The white books of 1919 and 1955 hold in common a focus on legal and biological aspects while the economics is absent, reflecting the weak position of economics vis-a-vis all public administration in Denmark even long after the active years of Warming (Topp, 2004). Fisheries management in most of the Western European Union member states was for a long time mainly influenced by biologists, while the influence of economics was absent. The 41 page Green book on the common fisheries policy (EC, 2001) did not use the word resource rent, since long a standard concept in fisheries economics for

⁶ Topp (2004) refers to a few exceptions, most notably the 1956 FAO meeting where a former Icelandic student of Warming, Ólafur Björnsson, introduced Warming’s model to the participants including Gordon and Scott.

the *rent of fishing grounds* discussed by Warming some 90 years earlier. However, the “Statistician against his will” (Davidsen, 1999) got a late revenge. During the new millennium priorities have changed and Danish fisheries are now managed by the rights based approach in line with Warming’s ideas that since long time have been advocated by most of his successors.

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The Danish Right to Eel Weir, by Jens Warming

In the Journal of Danish Economic Association, 1911, I wrote a seven page article on “Resource Rent from Fishing Grounds”. The paper was written from theoretical considerations, i.e., a by-product to a book on “Wage and Rent”, which led to considering various examples including fisheries. I did not know that the problem that I dealt with had such close linkages to a practical political issue. The issue is the abandonment of the Right to Eel Weir, which is currently discussed in commissions, the parliament, and in the general fishermen assembly. Neither did I know that a well-known Georgist⁷ author, the late S. Berthelsen, had suggested that some fishing grounds should be suitable for demarcation, measurement and valuation as a basis for a governmental fee.

The recognition my previous paper got in the fishermen’s paper and comments from hydrographical scientists indicated that my theories have practical relevance. When I read in the papers June, 1930, that the General Assembly of Danish fishermen unanimously had accepted a resolution which demands that the Right of eel weir should be abandoned I had to re-think the problem and clarify to myself that this would be detrimental from an economic point of view as the Right of eel weir leads to a regulation, which prevents waste of labor.

The Right to Eel Weir is an exception from the freedom, which otherwise applies to marine fisheries. There is a rule in the 1931 fisheries act that; no one can be excluded

⁷ Georgism, after Henry George (1839-1897), a philosophy and economic theory that follows from the belief that although everyone owns what they create, land, and everything else supplied by nature, belongs equally to all humanity. Georgists argue that all of the economic rent collected from land, broadcast spectrum, mineral extraction, tradable emission permits, fishing quotas etc., and extraordinary returns from "natural monopolies" should go to the community rather than the owner, and that no other taxes or burdensome economic regulations should be levied (*Added to this translation*).

from a properly visited and marked fishing ground, but you cannot achieve any property right to be transferred to other fishermen. To this comes the exception that a coastal owner has the right to fish for eel outside his land, and a separate panel of lay assessors should regulate the demarcation between the coastal owner's right and the free fishing right. This Right to Eel Weir is very old, but was rather extended when it was to be specified in the course of the work with the 1888 fisheries act (see Vinding Kruses' book Property Rights and its references). The Right to Eel Weir implies that the owner can charge a fee for setting up eel traps, which in many places generate substantial amounts, while in other instances, the amounts are so negligible that the owner offers free access. According to the Commission report on winding up the Right to Eel Weir in 1919, the right and a few other rights generated an annual 900,000 Danish kroner in pre-war prices.

It comes as no surprise that fishermen have a hard time understanding this difference that out at sea they have the full freedom as long as they do not disturb each other while near the coast they have to ask a non-fisherman for permission and possibly pay him for this. The latter arrangement in principle is the right one and that this principle is not applied on the high seas for practical reasons, i.e., calculating the fee and monitoring it would be most difficult, has not been explained to them. The previously mentioned Commission has, in spite of some disagreement regarding minor issues, unanimously suggested that the fishermen's request of winding up the right should be fully accepted. The suggestion has not so far been realized and the blame is put on the government, which according to some should reimburse the owners. Following a majority suggestion it is expected to be Danish kroner (DKK) 11-12 million, while a minority estimate it to DKK 5 million, as reimbursement will only be paid to some

owners. It is obvious that the Minister of finance is not enthusiastic about these suggestions. As such reimbursement would be a waste of money one can only support the Minister in his refusal. At today's price level it is likely that more than DKK 15 million will be thrown into the sea.

No fisherman will become richer if the government sacrifices these millions in order to relieve them from the current fees to the owners. In the long run there has to be a natural relationship between revenues from fishing, farming, industry, etc. If an industry due to any reason experiences higher revenues than other sectors, this will imply entry to this sector lowering the revenues either due to lower returns per man when more are sharing or due to lower price paid for the good, or in some other way. The fishermen now paying fees will experience that it was a questionable advantage being relieved from the fee as the enclosed guarantee of not too many fishermen was lost. If the reason for the entry flow is due to a progress in productivity it is beneficial and this progress will even out and be distributed all over society. But abandoning the Right to Eel Weir is not progress. On the contrary, fishermen that will enter can exist and earn a general income as the catch is supplemented with the relief of fees to the former owners. What they really produce is not enough and they could earn more in another sector. If the average annual gross revenue per fisherman is 2,000 kroner (where expenditures for boat, gear, fuel, etc. are deducted), we can assume as an example that newly entered fishermen increase their catch to a value of 1,000 kroner, but the government subsidizes up to the corresponding 2,000 kroner. Such great expenditures are usually not incurred to provide labor opportunities and it cannot be recommended to do it in such a manner, see below.

The fact is that the fee system, generated by the Right to Eel Weir, implies a regulating effect which corresponds to the property right of land. This arrangement prevents excess fishermen from entering and dissipating the rent, which is earned when the correct amount of fishermen is exploiting a fishing ground. This rent corresponds to the land rent, which should accrue to society but is earned by the private owner who has bought and paid for the ownership. Even if the government expropriates the value, it would still be correct to keep the fee system (as a land value tax), as the value would otherwise be dissipated benefiting no one and harmful to the general living standard.

My point of departure is the law of diminishing returns, which applies *inter alia* to agriculture and also in this case. Given that the minimum requested labor force to run a profitable farm is employed, an additional employee will lead to increase in total output, but not adding as much as the previously employed. The same applies to additional manure, additional irrigation, etc. I assume a similar condition for fisheries. An additional fisherman to a fishing ground may be positive to the others, given that they are few, but sooner or later additional fishermen will lead to diminishing returns. I will now illustrate my point with a simple numerical example, which disregards this initial stage (of increasing returns), and where returns are regularly diminishing. Later I will add figures where the subject can be further examined.

Let the catch along a given section of the coast be worth 100 kroner per week when exploited by a single fisherman, which increases to 190 kroner for two fishermen. The second fisherman, assumed equal to the first, is only adding 90 but earns 95 as he reduces the catch for number one by 5. Fisherman number three adds 80 but earns 90

by taking 5 from each of the other two. New entrants will add 70, 60, 50, 40, etc. Let us now assume that 65 kroner is the necessary gross earning per fisherman to yield the same return as in other sectors (the wage rate corresponds to what economic theory calls marginal productivity). Given these conditions, four fishermen is the optimal number for exploiting this part of the coast. Number four adds more than necessary, while number five adds less than what he would contribute in other sectors. Without regulation it is inevitable that more fishermen will enter than the optimal number. The first four will catch a total value of 340 kroner, i.e., average 85, which exceeds the normal 65 so much that numbers 5-8 can make a living by appropriating this surplus. The total catch of eight fishermen is 520 kroner, on average 65 each, which implies balance. If a ninth fisherman enters the average is down to 60, which leads to that one fisherman has to exit in order to achieve balance.

In case the coastline owner understands his own best, he will demand a rental fee of 20 kroner from each fisherman for the right to fish in his water. This implies that for the optimal number of fishermen, the average catch is worth 85 and each fisherman earns a normal income of 65. If the owner charges this price for a fishing license it is not necessary (but maybe beneficial) to also decide how many licenses he issues. Only four fishermen will lead to equilibrium, three fishermen would make $90-20=70$, which is so good that new entrants will be attracted, while five would make $80-20=60$ which is too little. This price of fishing license will lead to both the optimal number of fishermen and the maximum profit for the owner, which is $4*20=80$. If he would charge 25 per license only three fishermen would enter making $90-25=65$, which is enough for them, and his profit would be down to 75. In case he charges 15 there will be five fishermen entering giving him 75.

Hence, we find that there is full harmony between the private economies and the social economy; The Right to Eel Weir leads to that in order for the owner to maximize his profit, he will cut off the number of fishermen at the point which gives society the highest yield. There are other numerical examples in my earlier paper in the Journal of Danish Economic Association (1911) and in my report Denmark's Economic and Social Life, but I will now further illustrate the issue with some figures. We continue to exclude the stage with increasing returns, but denote the diminishing return by a curve: In the numerical example, returns were reduced by 10 for each additional fisherman which corresponds to a straight line. The curve in the figure indicates that if the first reduction in additional returns is 10, the next one is less than 10, and then further less etc.

[Figure 1]

The curve shows the diminishing returns, when number of fishermen is plotted on the x-axis. The line PD is drawn at the height where it shows normal income, including expenditures. The number of fishermen should then be OA, which means that the latest fisherman's product AB (marginal product) corresponds to the normal income.⁸ Altogether, the fishermen earn OABP while PBQ is the resource rent, but if there is full freedom and the resource rent is not collected, the small number of fishermen OA will earn AT, which is the average height of OABQ (given that RSQ = SBT). Such a high income will attract more fishermen and there will be an equilibrium at the number OC, given that PBQ = BED. At this level the total catch exactly covers a normal income to old and newly entered fishermen. However, the newly entered fishermen only produce ACEB and could potentially produce more in another sector and they achieve a normal income just because their output is supplemented by PBQ, which is the now dissipated resource rent.

In case there is a single owner that can regulate the entry, the resource rent will be saved; the owner would demand BT as a fee from each fisherman. This will lead to the optimal number, OA, as the fishermen pay PBTR in fees and keep OABP, which corresponds to the normal income. The owner earns PBTR, which equals PBQ, i.e., the resource rent. In case he would try a higher fee than BT per fisherman, the number of fishermen would reduce and give him a lower income, which is illustrated by the dotted lines. For example, if he charges HK there would be OG fishermen and the income for the owner would be lowered to HBI. The fishermen require OGHP as normal income, and the total catch yields PHIQ to the owner (=PHKJ, which

⁸ An additional fisherman would produce less than normal income, but stopping before A implies that an additional fisherman would generate a surplus. Hence, the optimal number of fishermen is OA. A private employer would have the same limit; A farmer hires labourers until the last one generates a product equal to his salary.

corresponds to the number OG times the fee HK, given that $MIK = JMQ$). In case the owner charges less than BT his total income would also be lower, as some of his resource rent would be used to supplement superfluous fishermen's income.

You can be despondent that this social value, like the land rent to the land owner, slips out of the hands of society. You have the same right to tax the value increase and the value itself as for the land. Still, it is better that the value accrues to a private holder instead of being wasted, which follows if the fishing is free. You can also appreciate that this value can be saved by a minimum of administration, which is a consequence of that the coastal owner, being present anyhow, demands the fee (See below about the case of a potential alternative administration).

Out at sea the corresponding value is also lost for those fishing grounds that could have yielded a surplus, given that the number of fishermen using it was given by the condition that the last fisherman added to the catch an amount corresponding to his labor value. Instead, the surplus attracts superfluous fishermen. The difference between the freedom out at sea and the regulation by the coast, which fishermen are now complaining about, should rather be eliminated and comprise regulation everywhere in contrast to freedom everywhere. The option of regulation out at sea has so far been excluded, and it is quite likely that the costs would outweigh the benefits from administration. Yet, I can imagine that there are fjords with narrow mouths where monitoring can be carried out relatively cheaply.

I will now explain another figure where the new element of overexploitation is included in the consideration.

[Figure 2]

The first figure was drawn in such way that all superfluous fishermen did produce too little but did contribute. However, if you draw the curve indicating normal income per fisherman at a lower level (either the absolute salary + expenditures is lower, or if it is relative due to higher returns), full freedom will lead to entry where fishermen reduce total catch, as they have a negative marginal product. I assume that the revenue curve intersects the x-axis and continues below, indicating that too many fishermen catch too many juvenile fish implying too little is left to grow and using the available feed. The limit for fish depending on food availability or predators is thus not achieved.

The letters have the same meaning as before. When the normal income is AB there should be OA fishermen, but then the resource rent, PBQ, is so big that under unregulated conditions new fishermen will enter until F, where a newly entered fisherman adds zero, and even to C where the last entering fisherman is harmful, valued to CE. Not until E is reached, the area BED outweighs the original large surplus PBQ, leading to a normal income AB for all fishermen. There are three groups of fishermen; OA, which produces more than normal income, AF, which produces less than normal income but still contributes, and FC, which is harmful. Still, no single fisherman belongs to a particular group and all fishermen work and earn the same amount.

I assume this is a common situation in real world fisheries, especially on the best fishing grounds, based on the many rules restricting fisheries. These rules have not been introduced to stop the low income fishermen AF, but to halt the harmful ones,

FC. If this goal is achieved, regulators are happy while the existence of the middle group is accepted, and the regulation is just aimed at the harmful group. *Natura non facit saltum* (Nature does nothing in jumps); you do not go straight from the fishermen with production above AB to fishermen with negative production.

It has to be admitted that protective regulation is not identical to rules aiming at restricting the number of fishermen. A minimum landing size regulation or banned fishing by river mouths means a prohibition to use fish today because its present value is too low compared to its future value, but the total number of fishermen will not be less due to such regulation. Regulating the number of fishermen on the other hand would likely make some of the current protective regulation superfluous, and the government monitoring could be reduced. A lower number of fishermen would lead to more care for the juvenile fish, not only for certain groups of them. Further, the number of fishermen most likely influences the shape of the curve leading to a perturbation of the mathematical link between number of fishermen and catch. The figure is intended to show catch when there are a constant number of fishermen denoted on the x-axis. If the number of fishermen is increased from the equilibrium at N, it is likely that catches would be higher as indicated by the dotted curve. Although, but the not completely insignificant number of fishermen, which can be defended in all respects, will in the long-run lead to a weaker fish stock than a pristine stock without human interference (I do not assume that we have a similar relationship to the case in the forest where logging of old trees improves growing conditions for the other trees and hence improves overall growth, see A.H. Grön: *Theory of Forestry Economics*, p.316ff).

In the previous mentioned commission a minority (Godskesen and three more) came with a suggestion in the right direction. They agreed with the others that the Right to Eel Weir should be abandoned with reimbursement to the owners. However, the right to fish should not be free but be distributed by the government. The right to fish should be well defined; such a demarcation could be at the depth of 6 meters with an addition of 10 meters (horizontally). The majority claimed that current conflicts (today handled by the Eel ground assembly) would remain and nothing would have been achieved. I suppose that these conflicts cannot outweigh the great economic benefits from regulation.

Also in Sweden (where former Danish rules are still in place in those parts that belonged to Denmark until 1658) takeover with leasing has been discussed. They refer to American role models and the Danish oyster rights (distributed by the king or the government). When considering which fish species (and lobster) that are suitable for such regulation, the choice is between migrating and stationary fish.

A great advantage with such centralization would be both protection from exhaustion and labor waste, and improved conditions for hatchery, combating harmful species etc., following when an owner or a tenant covers the expenditures and reaps the benefits, compared with the oyster rights. It will also require that greater water areas are run together, either as a cooperative formed by previous owners or by the government. It is likely to raise the administrative costs, compared to single owners, but may have big productive advantages.

Overall there are several ideas about regulation in the fisheries literature (albeit admitting that I have limited knowledge about it), which likely reflects the need for a substitute to the ownership that the landlord has of land.

Around 1920, when socialization was an issue in many sectors, government owned fisheries were discussed. Other thoughts apart from The Right to Eel Weir have been the idea of letting local fishery associations run fisheries. However, if this is done without charging the associations a fee there will be a lot of envy and complaints. In the Swedish debate it has been suggested that full freedom will not only be used by fishermen but also by the capital owners.

In a time like ours with so much unemployment, I have to defend myself against the potential objection that if superfluous fishermen are unemployed, it would be better if they were catching some fish instead of nothing. I have in other cases argued that instead of paying unemployment support, it is preferable to support unprofitable work to make them privately profitable. That means that for instance it is better to pay a general wage of 10 kronor per hour for work which is worth 8 kronor, instead of paying 2 kronor for no work. The costs are equal for the government (given that the money can be taken from the operating budget), while the unemployed is better off (He is getting the extra 8 kronor produced).

Still, we have to distinguish between whether the laborer is stuck in an unprofitable job or if he at short notice can get a more profitable job. In case of the latter it is unconditionally preferable, but if he is stuck in an unprofitable job it will lower the general level of wealth. The boom, when it finally arrives, should have full freedom to

alleviate the wealth level which also alleviates the wealth level in the following recession. During the boom, society's economic framework is extended, which determines the future wealth level. In case of a recession which lowers the wealth level by 10%, it is still better to keep 90% of a big number than 90% of a small number. Given that the boom has not been extremely unsound, there is no reason to believe that the reaction to a large expansion would be more vigorous than after a small expansion, so that society would end up on a lower level after the large expansion. It is not unsound to have full employment, and where would we end up if a large number of unemployed get stuck in unprofitable work during recession periods? Maybe we can sacrifice some of the benefits during the maximum level years in order to mitigate the poor years, i.e., when the marginal utility of a revenue growth is higher for the poor years than during the best ones. In case an annual expenditure of DKK 1 million to raise employment opportunities leads to a DKK 2 million reduction in wealth for many years, that is too high a price.

Let us from this perspective look through a few examples and finally the fishery. It is common knowledge that 'recession jobs', paying reduced wages, should be organized in a way which makes it easy to cancel them when other work is available that would benefit either the workers or the government. General construction work, which is started during depression to raise employment, cannot be cancelled in the requested manner but will reach a natural end, and release the workers for other purposes. As economic recovery does not come suddenly at full speed, it is enough to let the already started construction work to be gradually completed. In case of cultivation of unexploited land, planting, marling, trenching etc. can be pushed forward in gloomy times and slows down by itself in good times. This may be profitable for society

despite not paying a full salary or rent as otherwise idle workers and capital are used. Yet, if workers are tied up in an unprofitable sector, it will prevent them from moving to more profitable sectors (Cultivation of unexploited land may possibly be advocated on other grounds, see Denmark's Economic and Social Life). Also the public agricultural farm and their laborers may deserve governmental support, given that it is concentrated to the poor years, despite that they cannot afford normal wages on their own. When the Tobacco tariff was raised in 1908, the domestic growing (on West Funen) was increased until it was stopped by a national fee. The fee led to protests, where the argument was that many small holdings could get work and provision by this intensive growing. However, such a generous regulation would be active through all stages of a business cycle and this offer by the government through lower taxes for domestically produced tobacco implied sustained labor allocation whilst unprofitable, which would only occur as a result of favoritism. Maintaining tariff increases to provide work opportunities during a recession will tie laborers to an unprofitable activity. It is something different in cases of transitional movements due to rearrangement of production following a new tariff. In case a tariff change is motivated on other grounds, be it an increase, it is good to promote such changes during the recession so that the transition is carried out while a lot of workers are available. The military defense is employing many thousands of men, but that is not due to the argument that it provides labor opportunities. Since these people are employed through all stages of the business cycle, those that are hired in good times are then prevented from other employment that also could keep most of them during a recession.

Hence, there are occasions when it is possible to create more work artificially and there are other occasions when it is only apparent. Fisheries belong to the latter; it is hard to vary the fishery regulation to follow the business cycle, and it is hard to vary the number of fishermen. To maintain fishermen in a way so they do not create a growth in production, but only make a normal income at the expense of others, implies the prevention of getting the next economic up surge to reach the full level of wealth.